

Ion Stage Velocity Evolution in CO₂-generated LPPs

F. McQuillan¹, E. Sokell¹, & P. Dunne¹.

¹ UCD School of Physics, University College Dublin, Belfield, Dublin 4, Ireland

Background.

A benchmarking study has been undertaken to establish the accuracy of the plasma simulation software CRETIN as applied to CO₂ laser produced plasmas (LPP) from Sn targets. The key focus of the analysis has been upon ion stage velocities within both experimental and simulated plasma plumes.

Review

A review of previous experiments which used ion collection techniques to explore LPPs was undertaken. The results are shown in Figure 1.

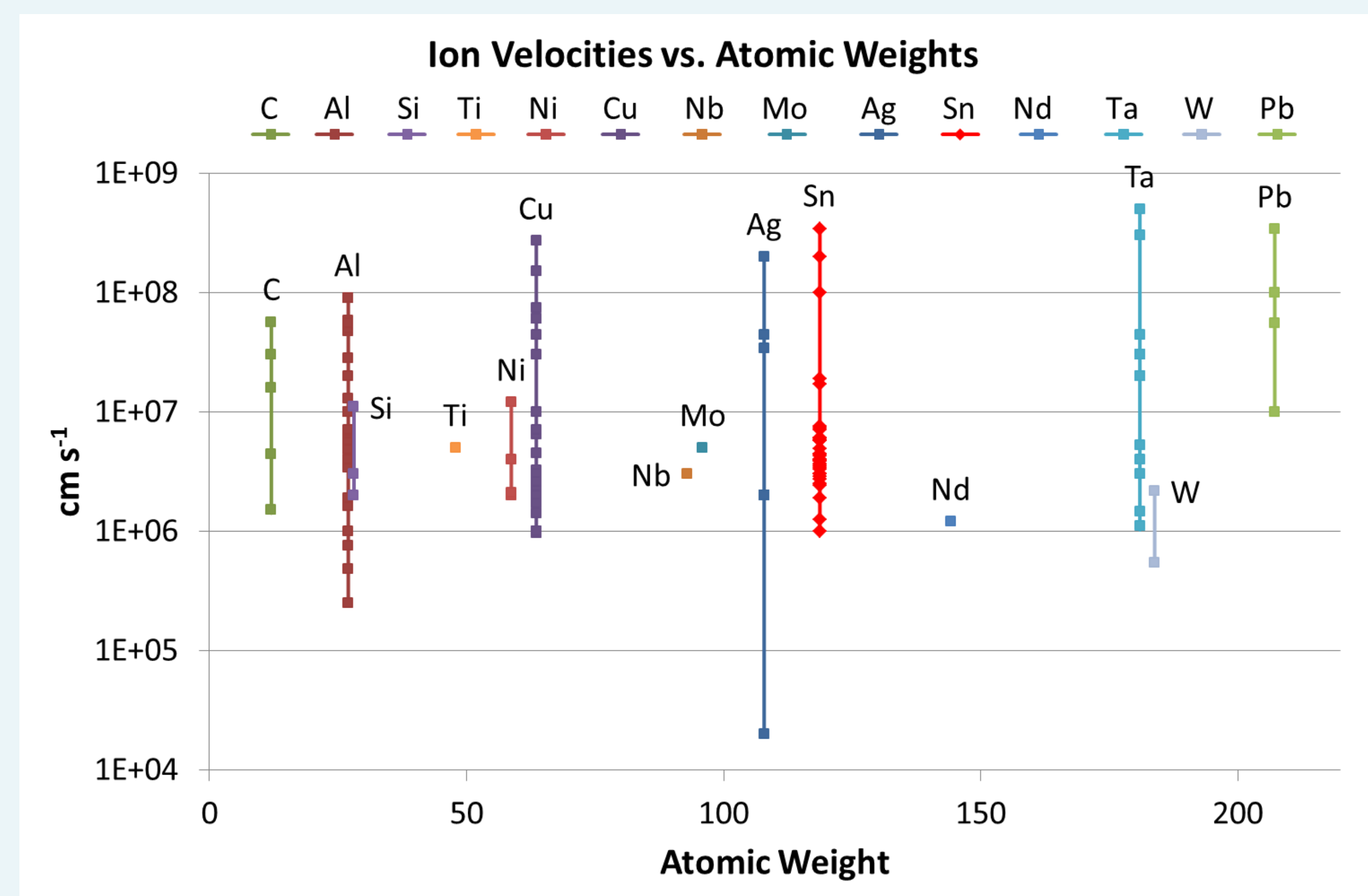


Figure 1: Review of previous experimental results

Experiment

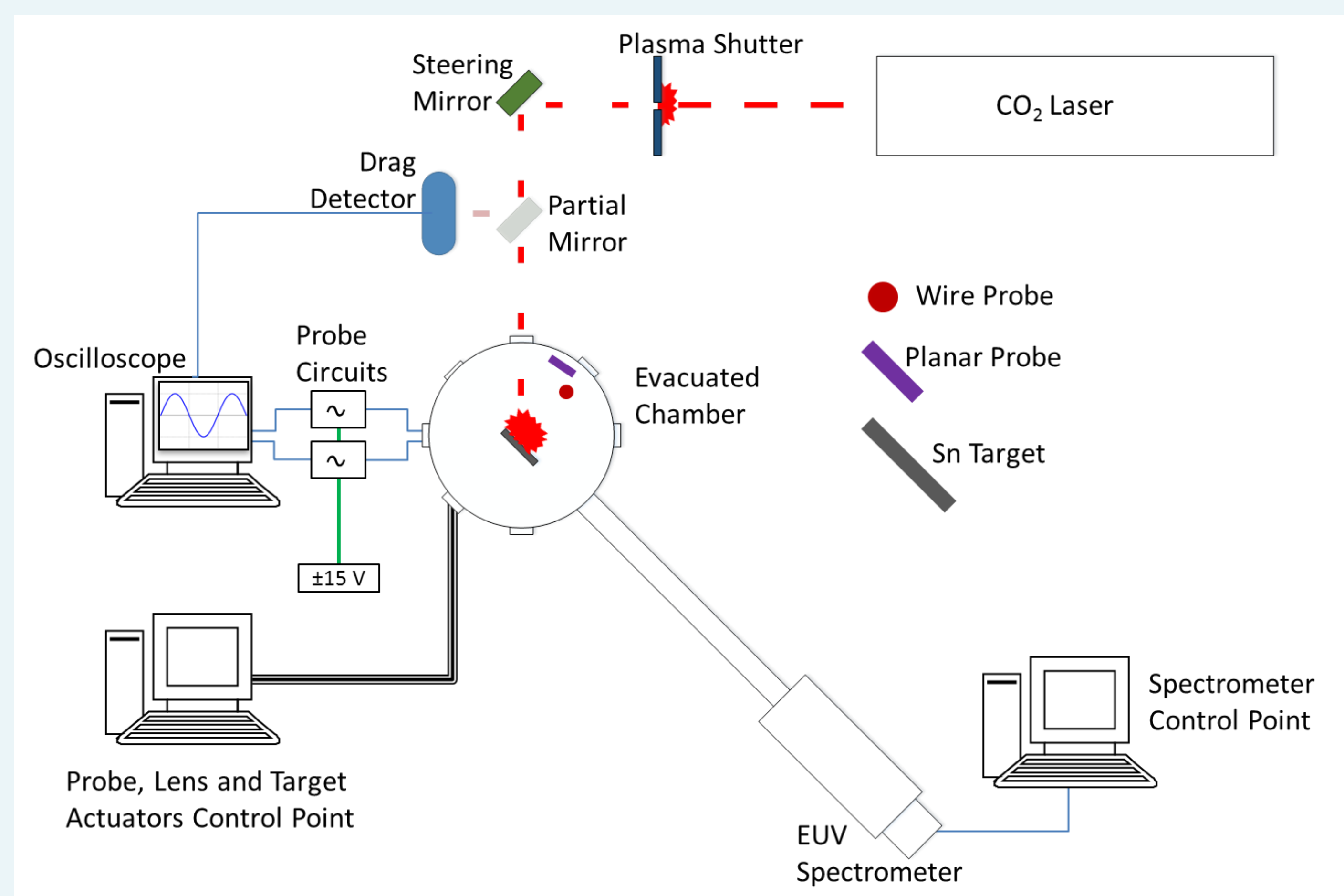


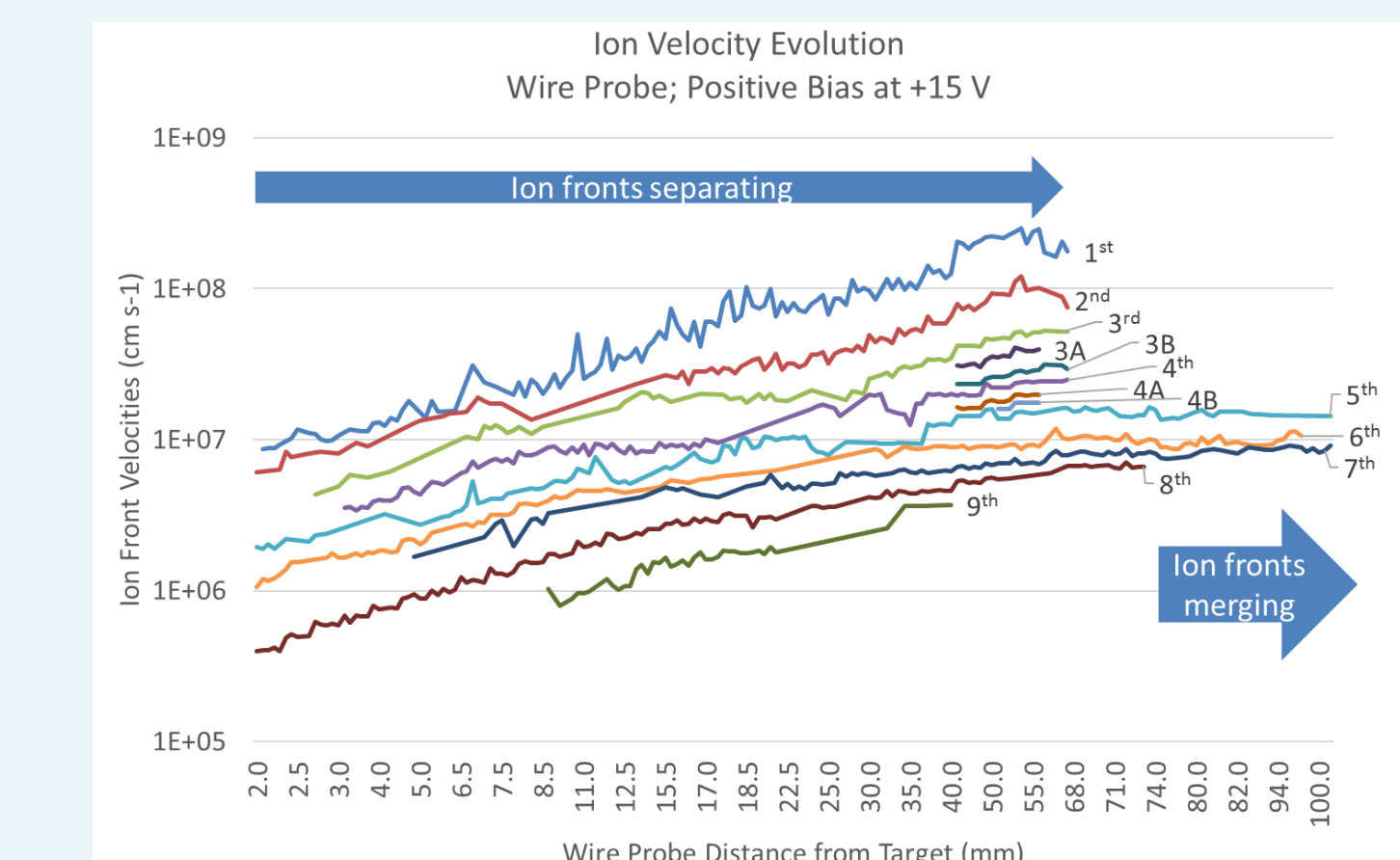
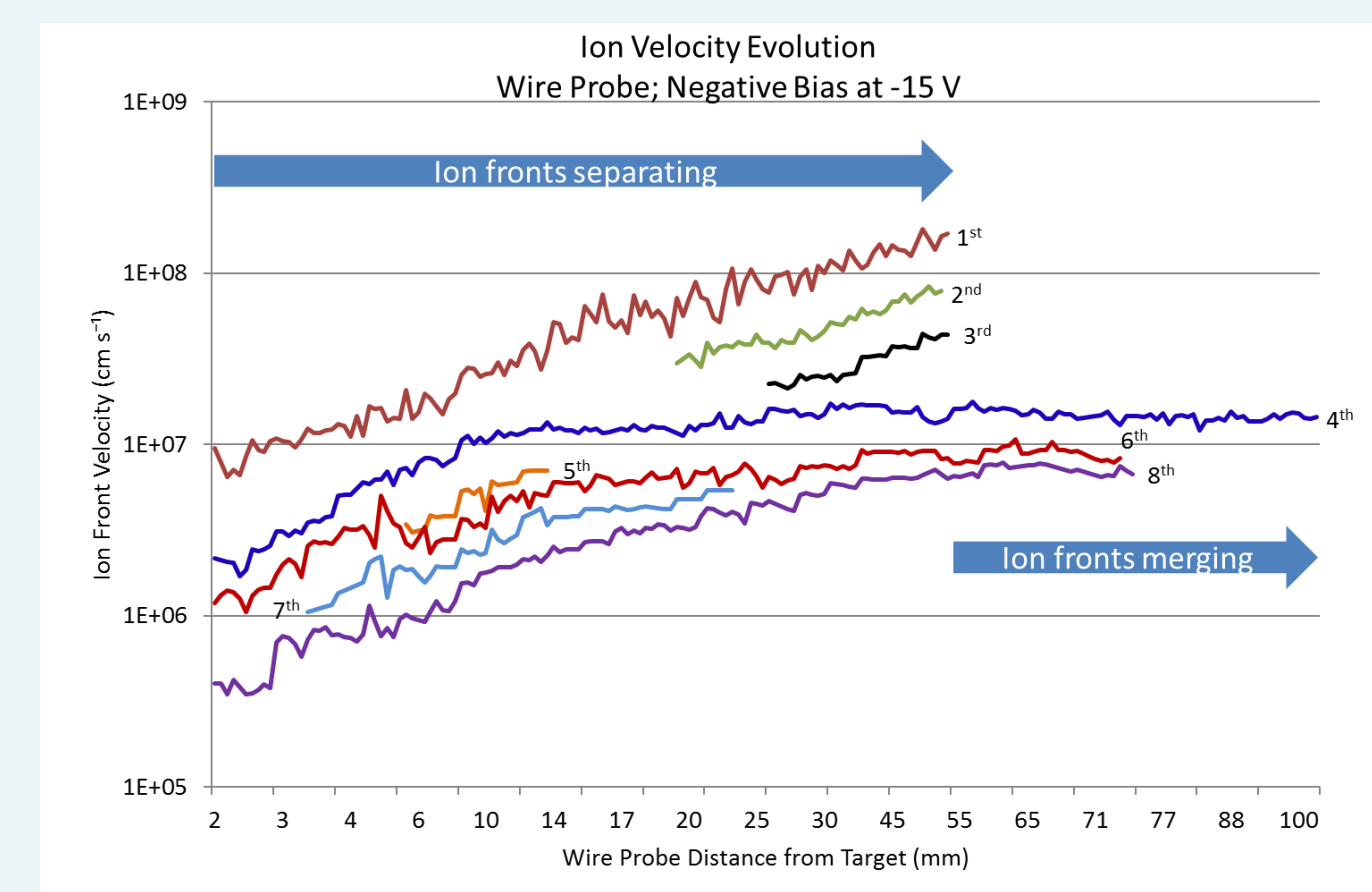
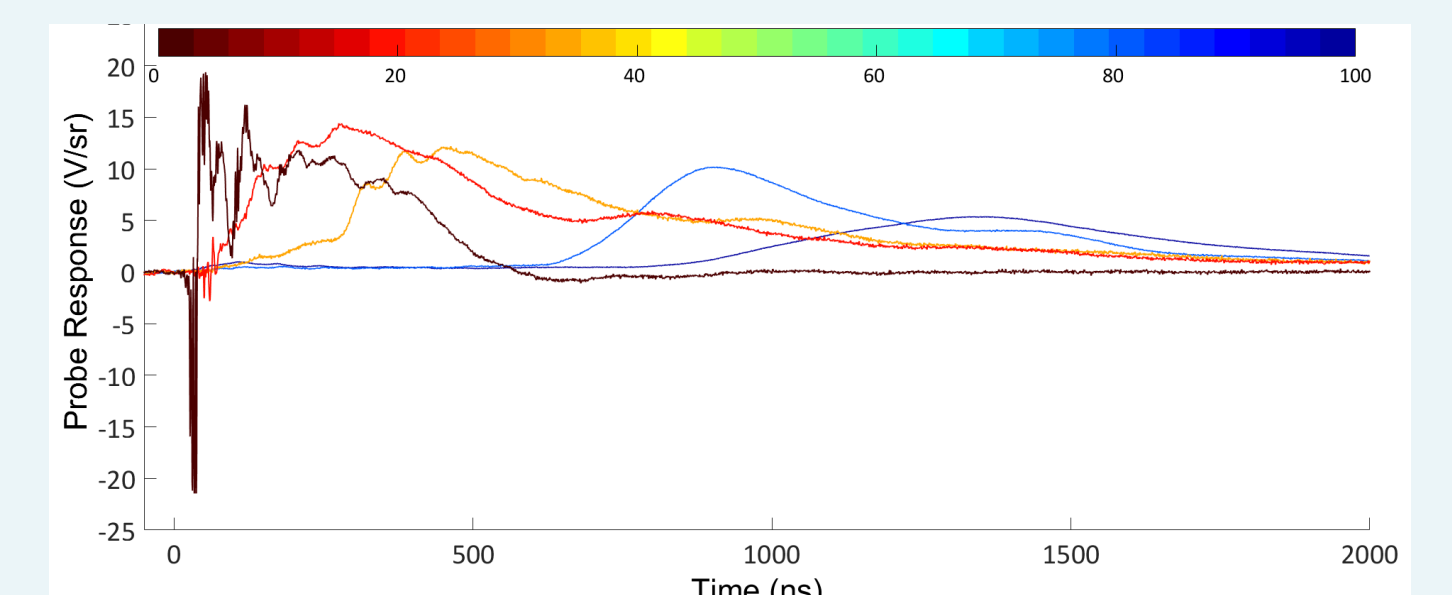
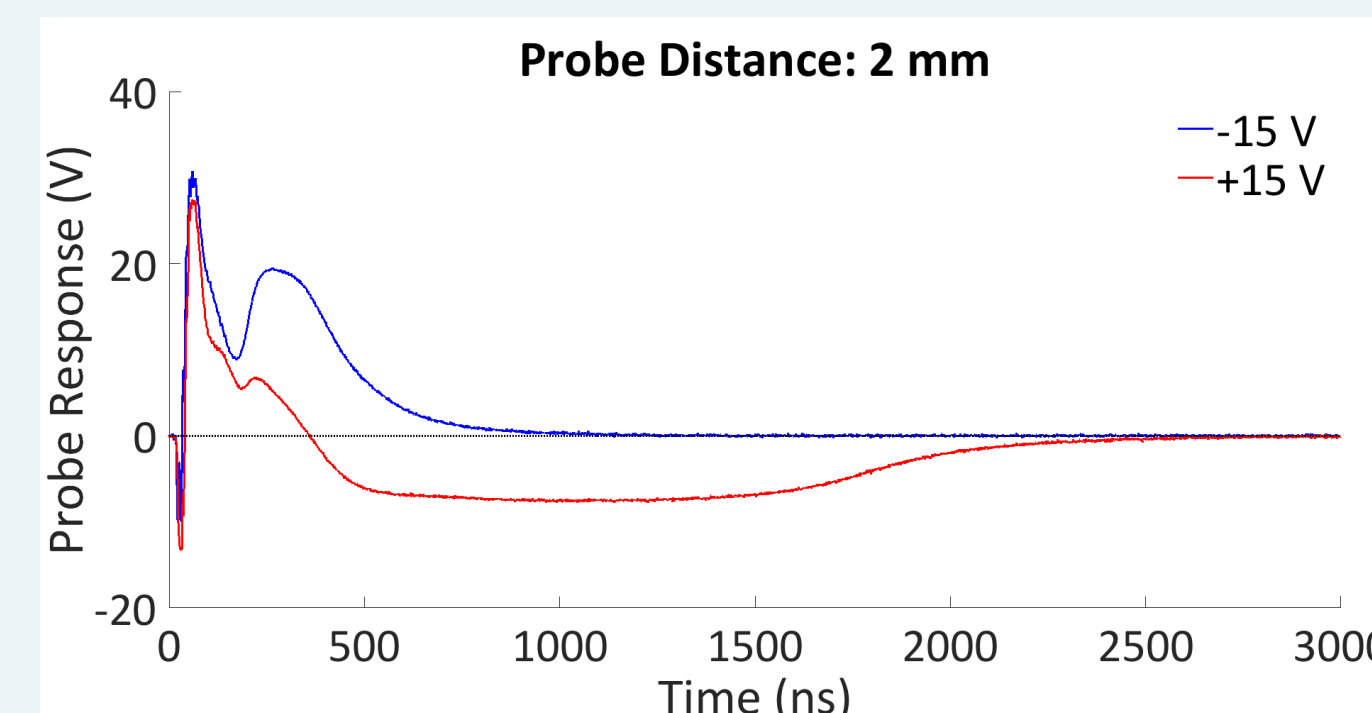
Figure 2: Experimental setup

Acknowledgements

This work was supported by Science Foundation Ireland under grant number 07/IN1/I1771.

Results & Analysis

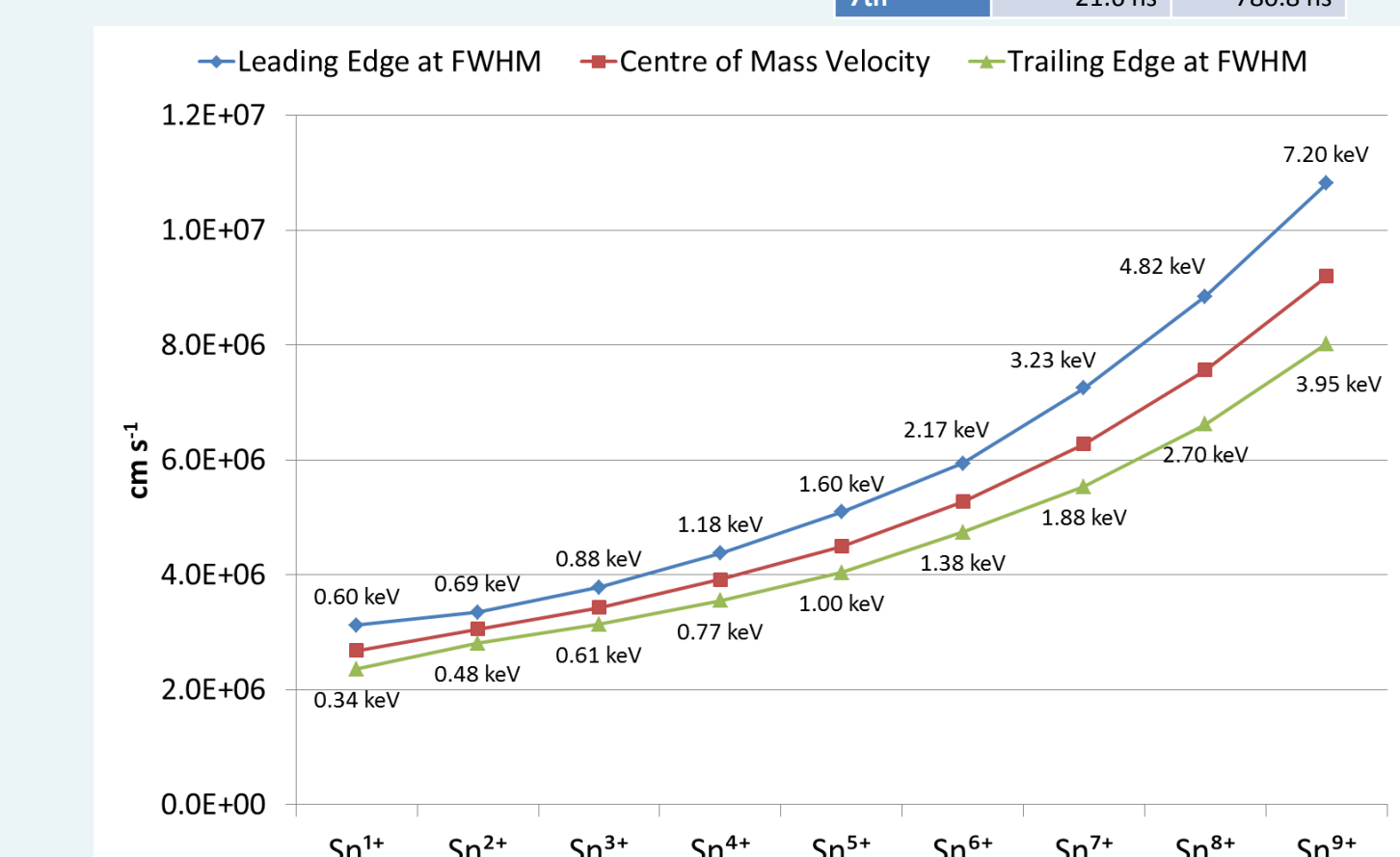
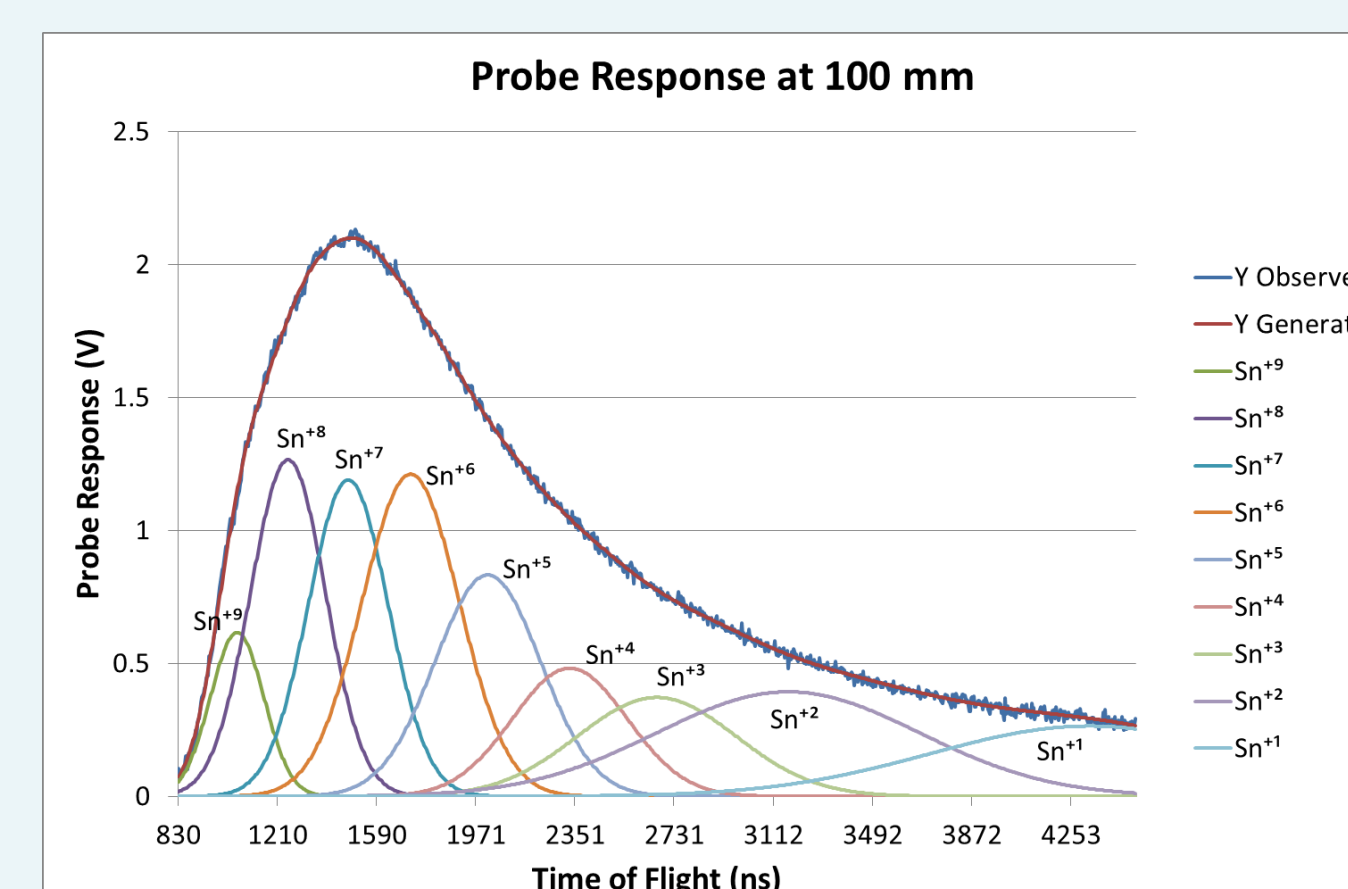
Probe responses to CO₂ LPPs were acquired over a range of distances between 2 mm and 100 mm. Following figures show a typical CRO trace of the probe response.



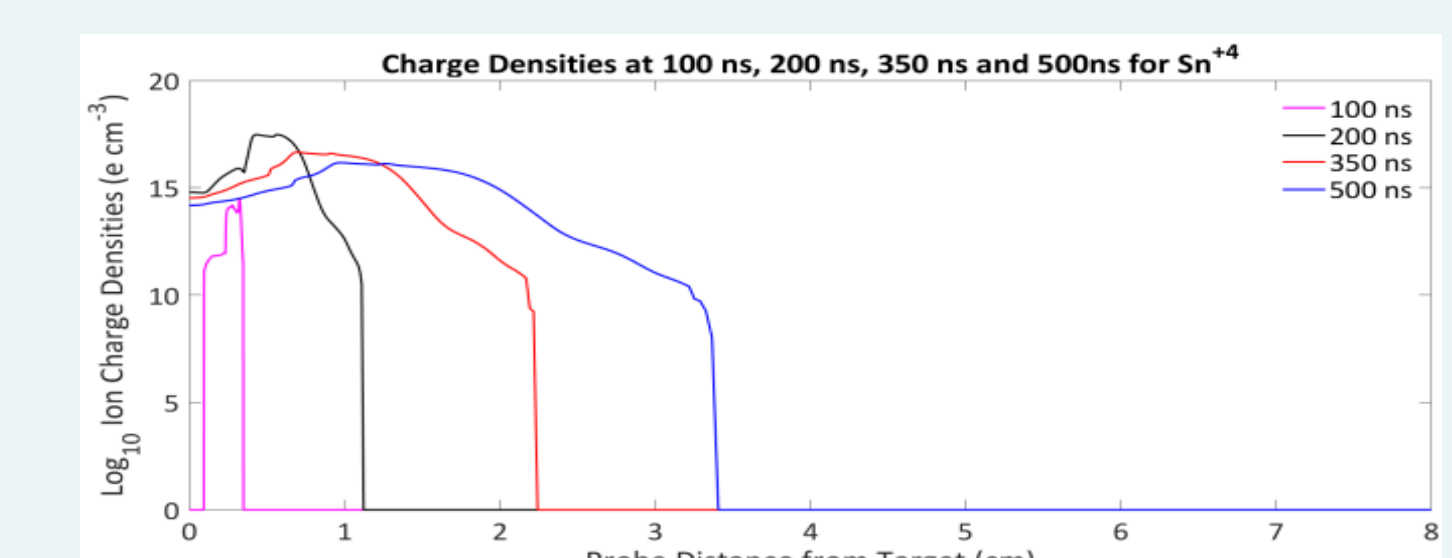
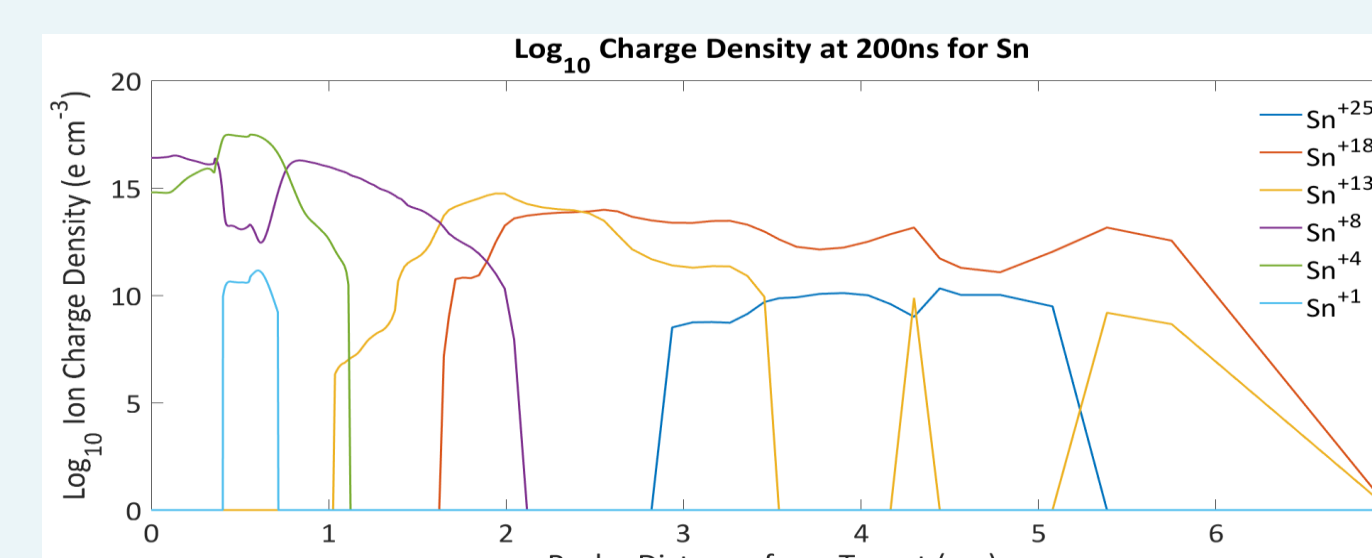
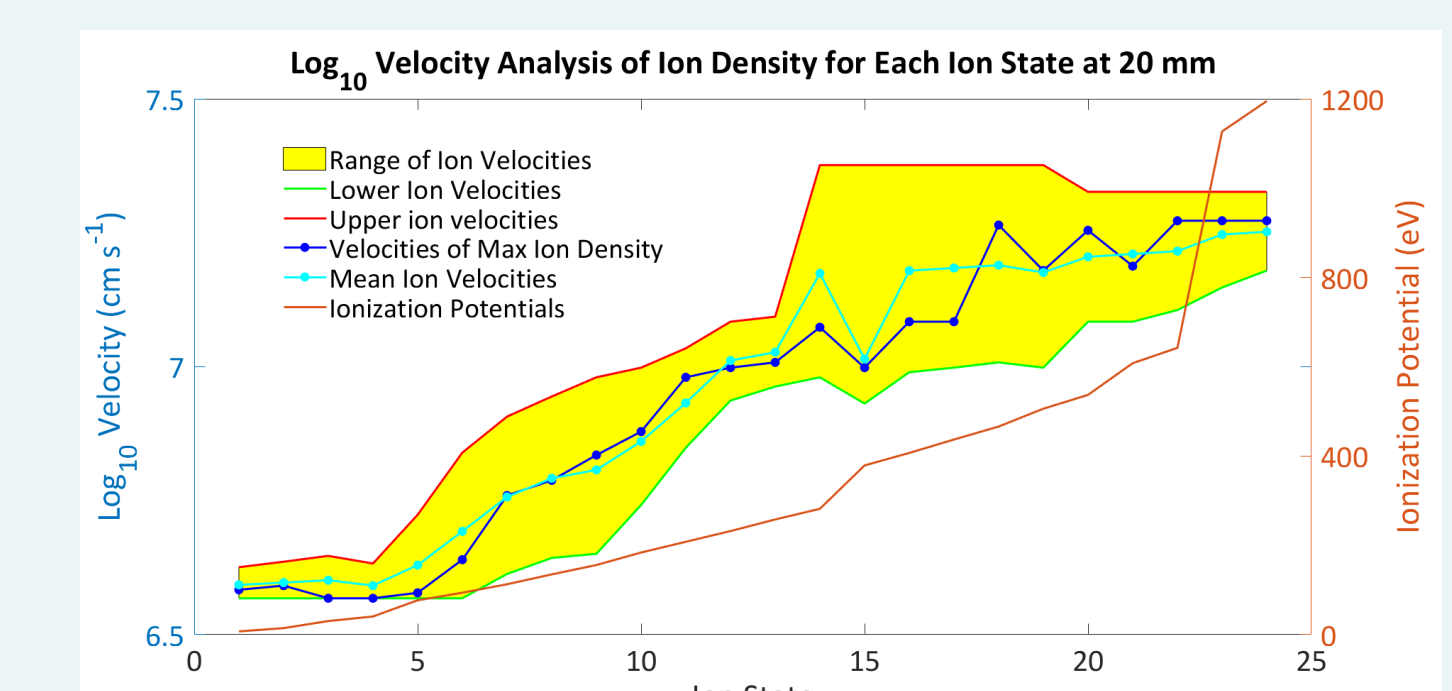
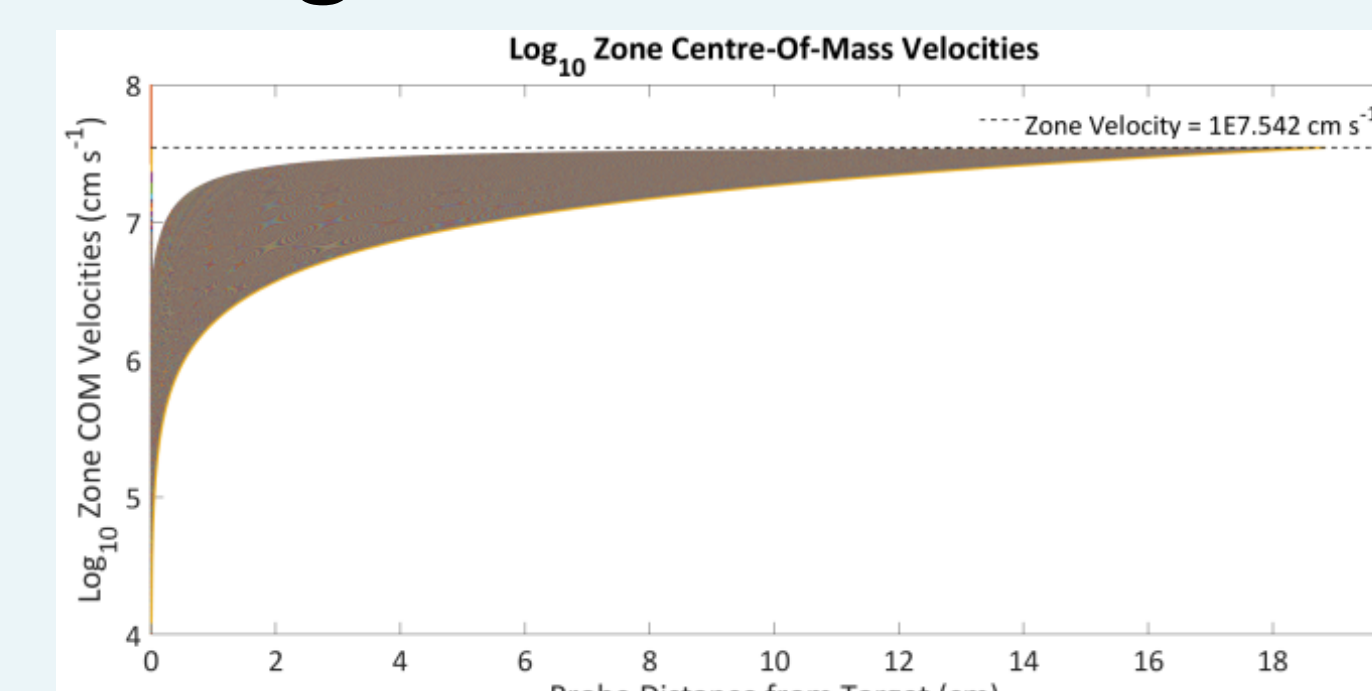
TOF Analysis		
Standard Deviation	Average	
1st	3.6 ns	30.8 ns
2nd	3.3 ns	68.5 ns
3rd	2.3 ns	121.2 ns
4th	3.6 ns	203.0 ns
6th	4.9 ns	404.0 ns
8th	7.3 ns	587.8 ns

Time of Flight (TOF) analysis yielded evidence of accelerating and separating ion fronts within the LPPs

Front Number	Standard Deviation	Average
1st	2.0 ns	23.5 ns
2nd	4.1 ns	52.2 ns
3rd	2.4 ns	108.0 ns
3A	2.7 ns	139.4 ns
3B	2.5 ns	192.8 ns
4th	1.7 ns	227.9 ns
4A	1.9 ns	277.8 ns
4B	1.1 ns	312.3 ns
5th	3.6 ns	363.4 ns
6th	14.2 ns	604.3 ns
7th	21.6 ns	780.8 ns



Deconvolution of the semi-gaussian portion of the CRO traces indicated the separation of ion stages by charge.



CRETIN simulations of the experimental setup replicate the ion stage acceleration and separation. The final velocity of the simulated ion stages is lower than that indicated by the experimental results.